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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/530,588	05/05/00	MATSUSE	K 2312-0866-2P

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EXAMINER	
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ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 05/22/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Applicati n N .	Applicant(s)	
	09/530,588	MATSUSE ET AL.	
	Examiner	Art Unit	
	Tuan Quach	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 March 2001* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *28-62* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *28-62* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
18) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other: .

DETAILED ACTION

The amendment filed March 5, 2001 has been received. Claims 9-16 and 24-27 are cancelled. New claims 28-62 are added.

Claim 39 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

"the gate oxide" in claim 39 lacks antecedent basis.

Claim 62 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Newly added claim 62 calls for the the barrier metal comprises a tungsten layer or a tungsten nitride layer and a tungsten silicide layer and a tungsten silicide nitride. The tungsten and tungsten silicide as barrier material are not supported by the disclosure. See the specification page 4 lines 22-24, page 5 line 3-4, lines 18-19, page 6 lines 6-7, page 8 lines 18-19, page 9 lines 7-8, page 11 lines 22-23, page 12 lines 22-23. See Figs. 1-4 and 6A-6F, barrier layer 14 of tungsten nitride or tungsten silicide nitride.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 62 is rejected under 35 U.S.C. 103(a) as being unpatentable over Agnello et al. or Kasai et al.

Agnello et al. (5,796,166) teach forming multilayer structure comprising polysilicon layer barrier refractorymetal-silicon-nitrogen intervening layer, and upper conductor thereon, e.g., including refractory metal such as W. The use of TaSiN and the replacement of W for Ta is also taught. See column 5 lines 10-17, line 56 to column 6 line 28.

Kasai et al. teach polysilicon, barrier WN, metal gate structure. See page 497, Fig. 2, page 499.

The tungsten and tungsten silicide are considered new matter unsupported as delineated above. Alternatively, such would be met or otherwise obvious over Agnello et al. and Kasai when the amount of nitrogen therein is minimized or reduced and correspond to tungsten and tungsten silicide and as such would have been obvious.

Claims 36-42 and 57-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Agnello et al. or Kasai et al. taken with Fleming et al.

Agnello et al. and Kasai et al. are applied above. The recitation of the atomic composition of nitrogen in the tungsten nitride, and of silicon and nitrogen composition in the tungsten silicon nitride correspond to well known optimization of one skilled in the art to obtain desired barrier characteristics and as such would have been obvious. Such optimization would have been further obvious given the teachings of Fleming et al., Figs. 1, 4, 5, and 9, evidencing the desired composition to obtain a desired resistivity; of Agnello et al. column 3 line 47 to column 4 line 1 evidencing the routine experimentation of forming varying compositions for such layer to optimize layer resistance, diffusion barrier characteristics, and stability.

Claims 38, 41, and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Agnello et al. or Kasai et al. taken with Fleming et al. as applied to claims 36-42 and 57-61 above, and further in view of Wolf et al. .

Although the references do not recite alternative conductor materials, it would have been obvious to one skilled in the art to have employed such conventional conductors to improve device characteristics as evidenced by Wolf, page 192-193, e.g., low resistivity, good electromigration resistance, etc.

Claims 39, 42, 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Agnello et al. or Kasai et al. taken with Fleming et al. as applied to claims 36-42 and 57-61 above, and further in view of Katoh.

Although the references as applied above do not recite all the alternative insulating materials, it would have been obvious and would have within the purview of one skilled in the art to have employed in Agnello et al. the alternative insulating materials in these claims since such correspond to conventional and advantageous insulating materials as evidenced by Katoh, column 1 line 60 to column 2 line 13, lines 53-64. Regarding any other insulating materials claimed, such use would have been obvious given the acknowledgment of such alternative materials in the specification page 12 lines 10-12, page 13 lines 14-15. In addition, official notice is given regarding such use of such materials for insulating layer.

Claims 28-35 and 43-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaki et al. (JP 9-260306) or Hah et al. (JP 9-186102) taken with Chiang and further in view of Fleming et al., Agnello et al.

Sasaki et al. teach forming contact through insulating layer using barrier material comprising WSiN 39 followed by conductor such as W or Cu 40. The planarization to form the plug is also. See the abstract and figures.

Hah et al. also teach forming contact hole in insulating film 36 followed by barrier tungsten nitride and conductor 44. See the abstract and figures.

Chiang et al. teach multilevel interconnection including barrier in openings, followed by conductor and then planarized, e.g, by CMP. Suitable barrier materials include various metal nitrides and metal silicon nitride, e.g., WN, tantalum silicon nitride, e.g., and conductor including Cu, tungsten, etc. See column 13 line 35 et seq., column 18 line 64 to column 19 line 18.

It would have been obvious to one skilled in the art in practicing the Sasaki et al. or Hah et al process to have employed on a conductor level or a metal layer in addition to a diffusion layer since such is conventional and advantageous as evidenced by Chiang et al. wherein such barrier structure is provided in multilevel interconnect. Conversely, it would have been obvious to one skilled in the art in practicing the Chiang et al. process to have employed the barrier materials taught in Hah et al. or Sasaki et al. since such correspond to conventional and suitable barrier materials taught therein.

The recitation of the atomic composition of nitrogen in the tungsten nitride, and of silicon and nitrogen composition in the tungsten silicon nitride correspond to well known optimization of one skilled in the art to obtain desired barrier characteristics and as such would have been obvious. Such optimization would have been further obvious given the teachings of Fleming et al., Figs. 1, 4, 5, and 9, evidencing the desired composition to obtain a desired resistivity; of Agnello et al. column 3 line 47 to column 4 line 1 evidencing the routine experimentation of forming varying compositions for such layer to optimize layer resistance, diffusion barrier characteristics, and stability.

Regarding the well known alternative conductor materials, and insulating materials, such are well known in the art as delineated above and as acknowledged by applicant and as such would have been obvious.

It would have been obvious and would have been within the purview of one skilled in the art to have employed such barrier between layers where barrier effect is desired, to have employed in conventional openings including contact openings or via openings where desired.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number is (703) 308-1096. The examiner can normally be reached on M-F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794. The fax phone number for the organization where this application or proceeding is assigned is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Tuan Quach
Primary Examiner